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RESULTS OF SPRAYING AND DUSTING POTATOES FOR LATE BLIGHT[1]

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(Accepted for publication Mar. 15, 1949)

The growing season of 1948 provided ideal epiphytotic conditions for testing fungicides against late blight of potato, *Phytophthora infestans* (Mont.) de Bary. The period was characterized by moderate temperature, high humidity, regular dews, and frequent showers, a combination of factors favorable to the sporulation, germination, and spread of the late blight fungus. The disease was observed on the sprouts and young plants in a small cull pile near Charlottetown on the 3rd of July, this being the earliest recorded date of its appearance in Prince Edward Island. The first field infection was found on the 26th of July, and

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by the 20th of August many unsprayed or inadequately sprayed fields were either dead or rapidly dying.

The variety Green Mountain, as in previous years, was chosen for the testing work because of its suceptibility to attack by late blight, and the plantings were made on the 3rd of June. Each plot was fifty-six feet long and three rows wide—the rows being forty inches apart. Unsprayed plots were alternated with the treated plots in each block of replicates. These plots were included (1) to serve as possible sources of infection, (2) to buffer the treatments, (3) to assure that all plots sprayed with fungicides would bear the same relationship to untreated areas, and (4) to serve as checks.

Seven applications of the fungicides were made beginning on the 19th of July and ending on the 15th of September. The machine was a tractor-sprayer unit, power take-off type, having four nozzles per row, and maintaining a pressure of 275 pounds. 50 W DDT at the rate of 0.75 pounds per 40 Imperial gallons was added to all spray mixtures except C. O. C. S. Niatox and Deecop, which contained this insecticide. The buffer and check plots were treated with DDT on the same days that fungicides were applied. The fungicides listed in table 1 were tested.

TABLE 1.—*Potato late blight fungicides used in screening tests,* 1948

Fungicide	Chemical	Formula
Bordeaux mixture	Cupric sulphate (25 per cent Cu.)—lime	4-2-40
Bordow	Tribasic copper sulphate and magnesium hydrate. 12.75 per cent Cu.	8-40
C. O. C. S. Niatox	Copper oxychloride sulphate 26.5 per cent Cu.	4-40
Deecop	Tetra copper calcium oxychloride 30 per cent Cu.	3-40
Dithane	Disodium ethylene bisdithiocarbamate + zinc sulphate — lime	1 qt. + ½ — ¼—40
Fungicide 629	Zinc nitrodithioacetate	1-40
Parzate	Zinc ethylene bisdithiocarbamate	1-40
Phygon XL	2, 3—dichloro 1, 4—naphthoquinone	1-40
Check	— — —	—

The plots were sprinkled four times during the first two weeks of August with water suspensions of late blight spores. These dissemi-

nations coincided with periods of showers, and a severe epiphytotic was rapidly built up. At first it was feasible to make counts of the lesions on the foliage; but later, when the disease reached serious proportions on the plants of certain treatments, this method of comparing results was abandoned, and it was necessary to employ the less accurate method of estimating the percentage of defoliation. However, by calculating the mean of the estimated defoliation percentages for a treatment it was considered that a satisfactory evaluation of the comparative efficiencies of the fungicides was obtained. The figures obtained on these counts and observations are given in table 2.

TABLE 2.—*Foliage infection—late blight fungicide screening tests,* 1948

Treatment	Lesions per Plant			Percentage Defoliation		
	Aug. 23	Aug. 27	Sept. 3	Sept. 11	Sept. 17	Sept. 23
Bordeaux	0.3	1.8	33.7	39	43	48
Bordow	0.3	2.4	35.9	36	41	48
C. O. C. S. Niatox	0.5	3.6	39.3	38	44	53
Deecop	0.9	7.5	39.2	39	44	57
Dithane	3.3	16.6	31.5	44	52	59
Fungicide 629	8.1	29.9	62.5	71	83	92
Parzate	0.7	4.4	11.4	25	29	37
Phygon XL	1.8	9.5	12.2	13	20	27
Check	N[1]	N	N	89	95	98

1. Numerous

It was noted that the four copper fungicides were of approximately equal value in controlling late blight on the foliage, Bordeaux mixture and Bordow being but slightly superior to C. O. C. S. Niatox and Deecop. Control differences exhibited by the four organic fungicides were great. Plants sprayed with Fungicide 629 were attacked almost as severely as the plants that received no treatment, 92 per cent of the foliage being dead on the 23rd of September compared with 98 per cent in the checks. Plots treated with Dithane showed a defoliation of 59 per cent or more than that recorded for the copper sprays, which ranged from 48 to 57 per cent defoliation. Parzate and Phygon showed outstanding promise under the severe conditions of the experiment, the percentage of defoliation on the 23rd of September being 37 and 27, respectively. Plants sprayed with Phygon XL were still very green when the tests were terminated on the 28th of September, when all plots were killed down by spraying them with a sodium arsenite vine killer. The plants in plots treated with other fungicides showed symptoms of senescence early in September and were quite mature, as indicated by the yellowish-green color of the foliage, before they were

sprayed with the vine killer. From this it would seem that Phygon has a propensity to delay maturity of potato plants.

The plots were harvested on the 8th of October and the tubers were weighed, graded, and examined during the last week of the same month. The results are given in table 3. This table gives further con-

TABLE 3.—*Yields and tuber infection—late blight fungicide screening tests,* 1948

Treatment	Total Yield in Bushels per Acre	Bushels Marketable[1]	Per cent Loss from Late Blight Tuber Rot
Bordeaux	275.4*	255.0	0.4
Bordow	294.3*	270.8	1.1
C. O. C. S. Niatox	299.1**	276.2	2.3
Deecop	255.1*	235.8	1.3
Dithane	257.6*	231.4	2.6
Fungicide 629	210.4	170.8	10.2
Parzate	290.8*	268.6	1.9
Phygon XL	254.6*	239.9	0 8
Check	199.5	160.6	6.6

[1]Total yield less undersized and rotted tubers.

*Indicates significant difference at 5 per cent level as compared with check.

**Indicates significant difference at 1 per cent level as compared with checks. Least significant difference at the 5 per cent level = 51.64 bushels per acre; at the 1 per cent level = 94.81 bushels per acre.

vincing evidence of the ineffectiveness of Fungicide 629. The yield obtained from the plots treated with this material was little greater than that obtained from the check plots, and the loss of 10.2 per cent of the crop from late blight tuber rot was far in excess of that resulting from any other treatment. Plots treated with C. O. C. S. Niatox, Bordow, and Parzate gave the highest yields, more than 290 bushels per acre being recorded for the plots receiving these treatments. Plots sprayed with Bordeaux mixture (4-2-40) produced an intermediate yield of 275.4 bushels per acre, whereas the Dithane, Deecop, and Phygon XL plots fell in the 250 bushel per acre class. In Prince Edward Island Dithane has never shown the excellent results that have been reported from certain other regions, although we have included it in our tests annually since 1945. Bordeaux mixture (4-2-40), which we always include as a standard treatment, has consistently shown superior results with regard to both yield and disease control. The mean yields over the four-year period are: Bordeaux mixture 289.9 bushels per acre, Dithane 275.1 bushels per acre; the mean percentages of loss through late blight tuber rot are: Bordeaux mixture 0.5 per

cent, and Dithane 3.4 per cent. The low yield of 254.6 bushels per acre obtained from plots treated with Phygon XL is completely out of proportion with its remarkable control of late blight. This fact further suggests that Phygon XL has a tendency to delay maturity and consequently depress the yield of potatoes.

TABLE 4.—*Comparative effects of dusts and sprays on yield and control of blight rot*

Chemical	Method	Total Yield in Bushels per Acre	Bushels Marketable[1]	Per cent Loss from Tuber Rot
Copper sulphate-lime	Dust	195.5	163.9	5.2
	Spray	256.9*	232.1	3.5
Copper oxychloride sulphate	Dust	249.1*	215.4	5.5
	Spray	260.0*	237.0	2.8
Tetra copper calcium oxychloride	Dust	232.4	196.5	5.6
	Spray	248.0*	225.9	2.7
Check		167.5	129.1	6.4

[1]Total yield less undersized and rotted tubers.
*Indicates significant difference at 5 per cent level as compared with check plot. Least significant difference at the 5 per cent level = 72.05 bushels per acre.

In another group of plots dry and wet applications of fungicides were compared. To facilitate the operation of the tractor-drawn duster the plots for this experiment were made larger, each being four rows wide and seventy feet long. The materials employed were: (1) copper sulphate + lime, (2) copper oxychloride sulphate, (3) tetra copper calcium oxychloride. Each of these materials was applied in both dust and spray mixtures, and formulae and rates of application were calculated to give equal copper dosage. Spraying was superior to dusting as indicated by greater yields and by smaller losses from late blight tuber rot (table 4). The sprayed plots produced a mean yield of 255.0 bushels per acre of which 3 per cent was lost from tuber rot, whereas the dusted plots produced a mean yield of 225.7 bushels per acre of which 5.4 per cent was lost from tuber rot.

SUMMARY

1. Four copper and four organic fungicides were tested against late blight of potato in Prince Edward Island during 1948 under severe epiphytotic conditions.

2. Phygon XL gave outstanding control of late blight on the foliage, and in this respect it was followed closely by Parzate. The four copper fungicides, Bordeaux (4-2-40), Bordow, C. O. C. S. Niatox, and Deecop, controlled the disease in the order listed, and were more effective than Dithane. Fungicide 629 gave almost no control.

3. It was evident that Phygon XL delayed the maturity of the plants.

4. All plots treated with fungicides except those treated with Fungicide 629 gave yields significantly higher than the check plots at the 5 per cent level. The yield resulting from the use of C.O.C.S. Niatox was significantly higher than the check plot at the 1 per cent level.

5. Three copper fungicides were applied in both dust and spray form.

6. Spraying was superior to dusting with regard to both yield and disease control.

NEW DEVELOPMENTS IN SEED POTATO CERTIFICATION

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The troubles encountered by certified seed potato growers have shown a wide variation in different parts of the nation. Aside from one or two hazards, usually occurring in each section, because of local environmental factors such as moisture and soil, problems in each community have often varied greatly from year to year. Seed potato growers should be fortified and always ready to expect the unexpected. It is very true that knowledge is gained by each past experience, but it seems impossible to project this into the oncoming season with perfect efficiency.

Most of the difficulties are attributable to the occurrence of old or new diseases. On several occasions, an entirely new disease for a community has developed in epidemic proportions with very little advanced warning. Many such diseases are correlated with weather conditions and insect populations. Luckily ,all of them are seldom rampant during the same season. Some formerly serious diseases have almost disappeared.

For many years previous to 1939, Spindle Tuber was by far the most troublesome virus disease in the North Central States. Since 1940, it has practically disappeared. It is seldom recorded in field readings or southern tests. Several insects are spreaders of Spindle Tuber, but this change is attributed to the advent of a moist cycle which resulted in a reduced grasshopper population. Nature seems responsible for almost eliminating this formerly very troublesome Spindle Tuber dis-

ease. With our present knowledge of grasshopper control, perhaps serious trouble in the future will be avoided.

In 1932, an infrequent and unusual type of affliction was noticed in an occasional certified field. More such plants were noticed in 1935 and Triumph and Cobbler tubers harvested from affected hills showed a large percentage of weak sprouts. In 1937, this disease occurred in epidemic proportions in some of the North Central states. It was given the name Purple Top Wilt. Tubers from Bliss Triumph fields showing 50 per cent Purple Top usually produced about 50 per cent very weak sprouts. Cobbler fields tended to show less disease and tubers still less weak sprouts. A large percentage of the plants in Pontiac fields may have Purple Top, but the tubers seldom produce weak sprouts. For the next few seasons, Purple Top Wilt occurred in varying amounts. Apparently, it was to be a great potential hazard to the seed industry, especially since little was known regarding the cause and control. This disease started occurring in various amounts eastward across the country. Leach attributed the disease to the Aster Yellows Virus being spread by six-spotted leafhoppers. Other workers have been able to accomplish transfer by this insect and by grafting. Conditions during the last three or four seasons have seemed favorable for the recurrence of this disease, including a plentiful supply of the six-spotted leafhoppers, yet its presence has been negligible. Some claim that the use of new insecticides is the controlling factor.

By the time Spindle Tuber ceased to be a troublesome disease and seed certification was getting to be a relatively simple matter in the North Central States, a new disease known as Ring Rot made its appearance. For a few seasons, it appeared as though it would be too high a hurdle for the Certified Seed Industry. Practically all certification agencies bravely set a zero tolerance and, in many instances, managed to keep its seed absolutely free or to commercially satisfactory mere traces. Because commercial potato growers dared not take chances with Ring Rot, they were practically forced to use certified seed and they soon learned that it paid to look for really dependable sources of certified seed. Although the battle with Ring Rot is still intensive, the certified seed industry, through liberal use of disinfectants and diligent effort to avoid all possible sources of contamination, is conquering the situation. Knowledge gained from scientific study has been important. In one or two areas, a surprisingly and unaccountably small amount of Ring Rot was to be found this last season. This causes one to wonder whether or not some unknown inhibiting factor may not be making inroads towards reducing the prevalence of this disease.

Some state certification agencies feel that they have found a way to practically eliminate Mosaic and Leaf Roll viruses. In other states these diseases are just beginning to present a problem. The occurrence and spread of these viruses are closely correlated with the presence of certain aphids. Aphid prevalence is correlated with weather conditions and preditor population. The fact that new insecticides are killing these preditors is presenting a new problem. A few active aphids can result in rapid disease increases. Very few aphicides, some still in the experimental stage may permit much more effective aphid control. Recently, the practice of early vine killing is showing a very marked improvement in control, especially of Leaf Roll.

Potato Scab continues to be one of the most common troublesome diseases. It is probably the biggest single factor in the eliminating and shifting of production areas. Although an enormous amount of study and research has been concentrated on this disease, not a great deal of actual over-all progress in control has been made and it continues with its ravaging and costly progress. In some instances, artificial manipulation of soil reaction has accomplished control. Recently, certain crop rotations, which include rye, are proving beneficial. Varietal resistance is playing an important role and will become more important. Startling results with practical partial soil sterilization may be developed. Hot formaldehyde seed dip is proving the most effective dip.

Marked advances have been made in developing new fungicides for the control of both Early and Late Blight. The use of chemical vine killers and mechanical vine shredders has developed rapidly and helps not only in blight control, but permits early harvest of more mature stock. In many instances, mechanical vine elimination has also made very practical the use of labor-saving mechanical harvesting machines.

Research has greatly helped the potato industry, but has not kept pace with all certified seed producer's problems; hence, in many instances, he has had to surmount them through tiresome and costly effort. The most efficient method for developing good foundation stocks is resulting from careful indexing and tuberline increases. A state is fortunate when it has an area in which foundation stocks can be started and maintained from year to year.

Recently there has been a more widespread use of commercial fertilizer. Higher yields have resulted. In many sections, fertilizer trails have been carried on regularly to discover the best combinations and best methods of application. Where this has been done, one would assume reaching utmost efficiency. New ideas and developments, however, may

[1]North Dakota State Seed Commissioner.

greatly change fertilization practices.

It seems that potato research, including potato breeding work, has just started to gain some real momentum. New varieties will eventually solve many of the present problems. Plant breeders should make much greater effort to eliminate viruses from their new releases. Recent unequal advances in freight rates, improved ways of combating some of the troubles mentioned above, acreage control and price support programs may tend to cause increased production nearer consuming areas, thus affecting present producers of both seed and table potatoes.

As the result of more fertilization, better insecticides and fungicides, larger yields and improved quality are made possible. If better yields and better quality become easier to maintain, a smaller total acreage will be required to supply the table needs of the nation. Less certified seed acreage will accordingly supply the seed market. There will be need for a readjustment of certified acreages. Some relocation of acreage might take place. Even though the growing of good certified seed has been an almost unsurmountable task, the supply has often exceeded the demand with the result of little or no price premium. States might aid greatly in correcting this situation by tightening requirements both in the field and in the final pack.

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CONVERSION OF POTATOES TO STABLE FORM[1]

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(Accepted for publication Feb. 9, 1949)

The greatest drawbacks to the industrial utilization of potatoes are their great bulk and perishability. The obvious way to overcome these is to convert the potatoes to stable form by drying. Consequently, the Department of Agriculture's Eastern Regional Research Laboratory has been engaged in engineering research on a pilot-plant scale to develop cheap methods of accomplishing this.

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[1]Presented at the meeting of the Potato Association of America held in Pittsburgh on November 16, 1948.

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What is so difficult about drying a potato? Those of you who have tried it on a commercial scale will have some ideas on that point. To begin with, you must evaporate about 4 pounds of water to get 1 pound of dry solids. So you decide to press out some of the water first and save drying costs. Then you find that you have lost nearly 20 per cent of the solids, and your reduced yield may have more than offset your savings in drying. Or perhaps you got into difficulty with the local authorities for putting the press effluents into the river. If your drying was done in a direct-heat drier without precautions to avoid a spark, you may have had a fire or an explosion from the finely divided starch. If you were fortunate enough to avoid these troubles, you no doubt observed that the ground potatoes rolled up into pellets the size of marbles, the insides of which remained soft and doughy even though you dried the outside to a crisp.

Perhaps, instead of grinding the potatoes you decided to slice them and use a direct-heat drier. Then you undoubtedly had the unpleasant experience of having the slices stick to the drier or stick to each other, forming lumps the size of footballs. But you don't want to hear about processes that fail; you want to know about the ones that function.

There are three physical forms in which a potato may be feasibly dried: raw ground, raw sliced, and cooked and mashed. Let us consider first grinding them raw.

Steam Tube Drier Process for Feed

Figure 1 shows a process for producing feed from raw ground potatoes with a steam tube drier. Here the potatoes unloaded from a box car are flushed by flume to a conveyer, which delivers them to a washer. This may be any one of a number of types. The one commonly used in starch factories is simple and efficient. It consists of a semi-cylindrical tank divided into compartments and partially filled with water. A shaft with agitators runs the full length of the tank, and paddles lift the potatoes from one compartment to the next. The clearance between the paddles and the shell is such that the stones are left in the trough and periodically removed with the dirt. The washed potatoes are ground in a hammer mill having ¼-inch holes in the screen. The ground product is delivered to a mixer conveyer, where a sufficient quantity of the dried product to achieve a moisture content not exceeding 45 per cent is incorporated with it. This is equivalent to recycling about 1.1 pounds of dried product for each pound of potatoes ground. This recycling is roughly analogous to refluxing part of the product obtained in fractional distillation.

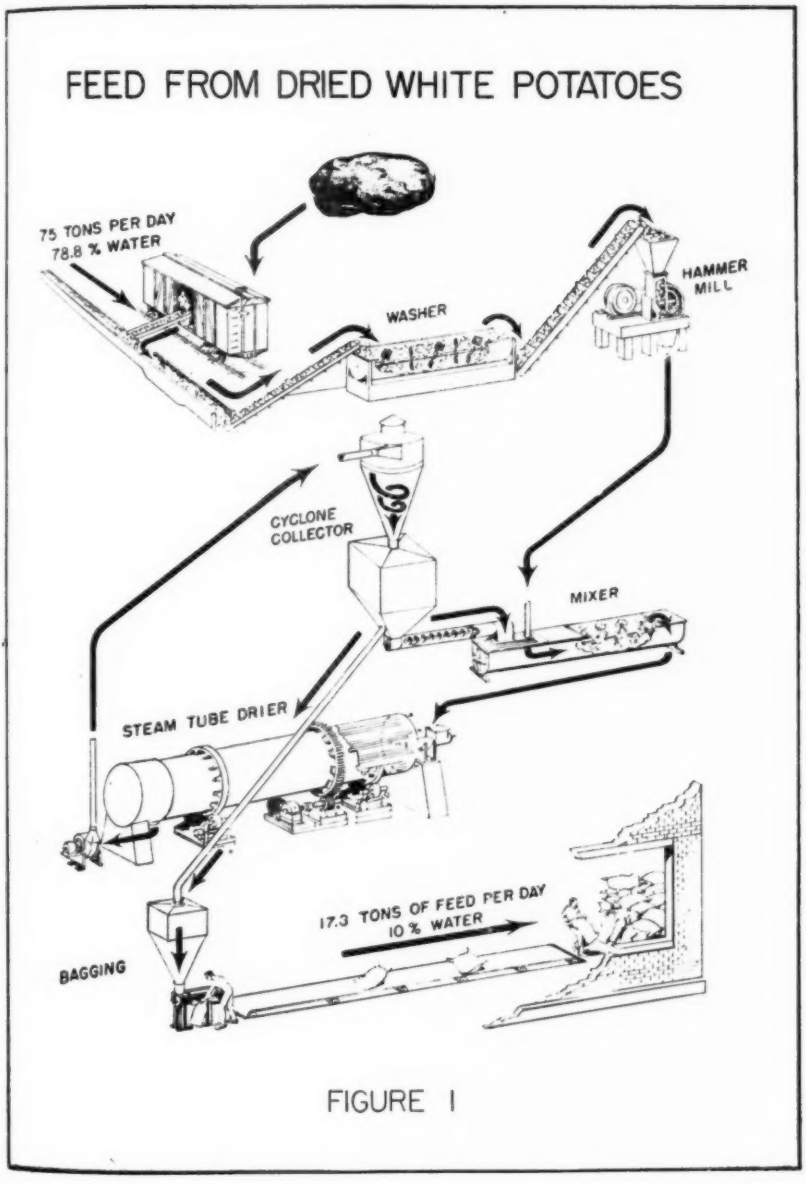

FIGURE 1

A thoroughly mixed product below 45 per cent moisture can be fed to a rotary steam tube drier without danger of sticking. Higher moisture contents cause the potatoes to coat the steam tubes, resulting in a mixture of burned and under-dried material. The entire product from

the drier is delivered by a blower through a cyclone to a bin. From the bottom of this bin, the proper proportion of the dried product is sent to the mixer conveyer. The speed of this small conveyer from the bottom of the bin is variable, as is the speed of the belt conveyer going to the hammer mill. The conveyers are adjusted to give the desired 45 per cent in the mixer conveyer. All the dried product not required for recycling automatically overflows from the bin and is bagged. The product is light brown and contains all the protein, minerals and carbohydrates that were in the potato.

Cost

We have estimated that a plant capable of processing 75 tons of potatoes per 24-hour day could be built for an investment of $80,000. Such a factory would produce a little more than 17 tons per day of feed at a cost of slightly more than $24.00 per ton. This figure represents all costs except that of the potatoes and selling costs for the product.

Steam Tube Drier Process for Flour and Meal

Figure 2 shows how this basic method with slight modification can be adapted to the production of potato flour. The differences between this picture and the one you have just seen are (1) an inspection table to eliminate bad potatoes, as the product will be used for food; (2) an agitated tank for sulfur dioxide; and (3) facilities for grinding and screening the dried product to produce flour and meal. The amount of sulfur dioxide required to give between 200 and 500 ppm in the flour is about .075 per cent of the weight of the potatoes. Even this small quantity will cause some corrosion, but this will occur almost entirely in the exhaust duct system from the steam tube drier. For long life this duct should be made of stainless steel.

To insure preservation of the dried food product, its moisture content must not exceed 9 per cent, whereas in feed the moisture content may be as high as 12 per cent. The dried food product will be very light cream in color. It is ground in a hammer mill and screened through a 30-mesh screen superimposed over a 70-mesh screen. The product passing through 70-mesh is flour; that held on the 70-mesh screen and passing through the 30-mesh is meal. The little that remains on the 30-mesh is returned to the hammer mill for regrinding.

Cost

A factory processing 75 tons of potatoes per day into flour or meal by this method would cost about $87,500. It would produce between 16

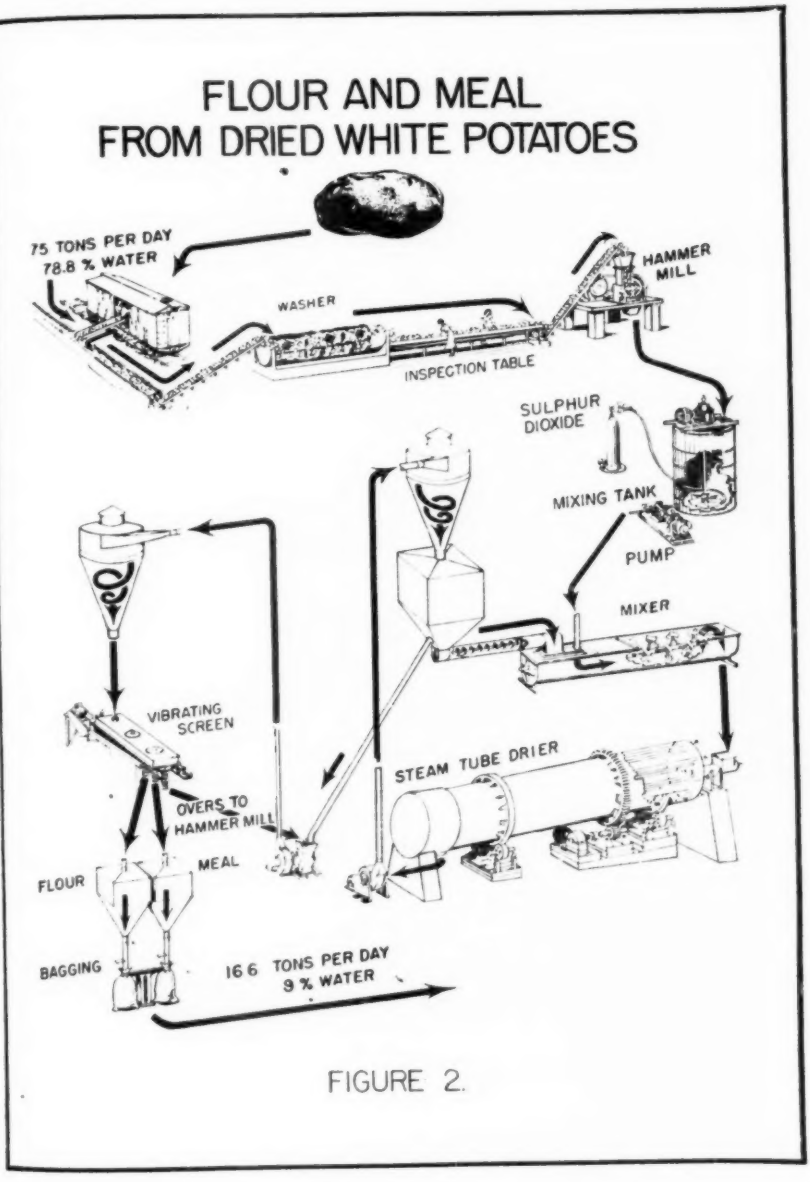

FIGURE 2.

and 17 tons per day, and the over-all cost of the product would be about $39.00 per ton, including all costs except that of the potatoes and the selling costs. Even if the price of potatoes were included, the cost of making the product would be considerably less than that of the conven-

tional process using cooked potatoes and drum driers. Is the product as good? Its color is only slightly on the cream side, as compared with the standard product, and it is entirely satisfactory for use in dehydrated soups, into which much of the material will go that is required by the Commodity Credit Corporation for European uses. We do not yet know what quality bread it will make, but we suspect it may have different properties from standard potato flour, as it was made from raw potatoes instead of cooked potatoes. We hope later to have more information on this point from the U. S. Bureau of Home Economics and Human Nutrition.

Pressing

At this point one might logically inquire why in these processes for producing feed and food with a steam tube drier, pressing cannot be used to remove some of the water and reduce drying costs. This has been done successfully, and the flour made from pressed potatoes is probably slightly lighter in color than that from unpressed potatoes. However, approximately 20 per cent of the solids are lost by pressing, including nearly 50 per cent of the protein as well as valuable materials and carbohydrates. The press effluent constitutes a disposal problem, and the cost of pressing may be greater than the savings which it achieves.

Figure 3 shows what the process would be if pressing were included. You see a cider press substituted for the recycling device. There is no need to recycle, if the moisture content is reduced to 56 per cent by pressing. With the elimination of some of the sugars and proteins, there is less tendency to stick, and consequently there is no necessity for reducing the moisture content to 45 per cent. Continuous rotary presses cannot be used, as it is not feasible to reach a moisture content of 56 per cent by that means. SO_2 must be used for pressing instead of lime when the product is for food use. The amount required is 0.2 per cent based on the weight of the potatoes. The method depicted here has been used on a commercial scale, and a good product produced, but we estimate that pressing would increase the cost about $2.00 per ton of product.

Direct Heat Driers

We should not leave the discussion of drying ground, raw potatoes without mentioning the possibility of using a high-temperature, direct-heat rotary drier. It is entirely possible to use such a drier when the moisture content of the feed is reduced by pressing or recycling to the point where it will not stick. However, there can be an element of hazard here because of the explosive properties of finely divided starch

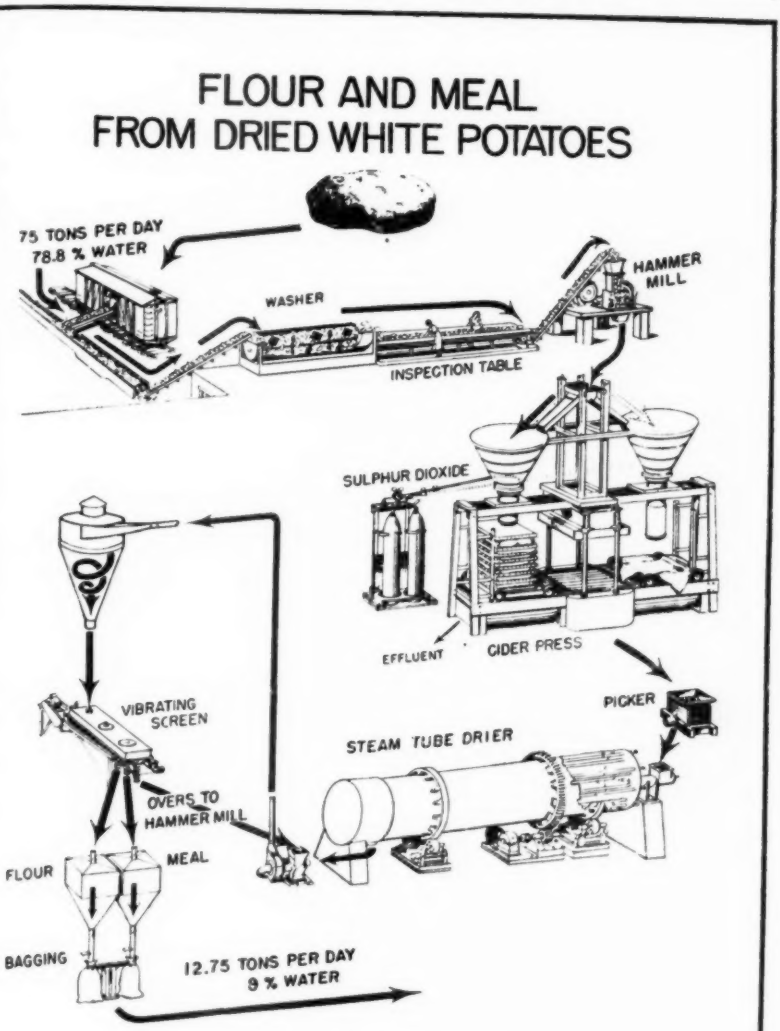

FIGURE 3.

suspended in air. Precautions must ensure that no spark can reach any explosive starch-air mixtures that may exist.

Sliced, Raw Potatoes

We have just mentioned the hazard which can be involved in the direct-heat drying of raw ground potatoes. Why not then cut them into

small, uniform slices to minimize the release of starch and dry them in direct-heat driers? Any one who has tried this will know the difficulties encountered because the potatoes stick to the drier. Even though this may be prevented, the slices tend to case harden and to dry very slowly on the inside. The Germans, however, during the last war, succeeded in drying sliced potatoes in direct-heat beet pulp driers. After soaking, this product was cooked and served to the German Navy. During the survey of European practices for potato utilization we found that they solved the sticking problem by slicing the potatoes uniformly and coating them with ground dried potato. Following this idea and utilizing a drier of domestic manufacture, we have overcome the sticking difficulty and succeeded in drying potato slices. These may be ground to produce feed, or if the color is maintained with sulfur dioxide the product will be satisfactory for certain grades of potato flour.

Cost

We do not yet have enough specific data to make reliable cost estimates on direct heat drying of sliced potatoes, but we believe it will be somewhat higher than that of drying them ground in a steam tube drier.

Cooked Potatoes

The third form in which potatoes may be feasibly dried is after cooking and disintegrating. Last July when the Commodity Credit Corporation invited bids on potato flour in a quantity more than 10 times our normal capacity, the Eastern Regional Research Laboratory was faced with the problem of finding other means whereby existing equipment could be utilized. Figure 4 shows one process developed. It consists merely of adapting double-drum driers of the type commonly used for drying distiller's solubles. Although drum driers are conventionally used for making potato flour, they are of different design. The drums rotate upward and away from each other at their nearest point of contact, and the thickness of the mat on the drum is controlled by superimposed small-diameter rollers. In adapting distillery drum driers, the problem was to deposit uniformly a layer of the cooked potatoes on the drums. In this case, the drums have no superimposed rollers, and they rotate downward and away from each other at their nearest point of contact. The thickness of the layer is determined by the clearance between the rolls.

The solution to the problem proved comparatively simple. If the cooked potatoes, while kept at a temperature about 150° F., are passed through a hammer mill to reduce them to a smooth creamy consistency

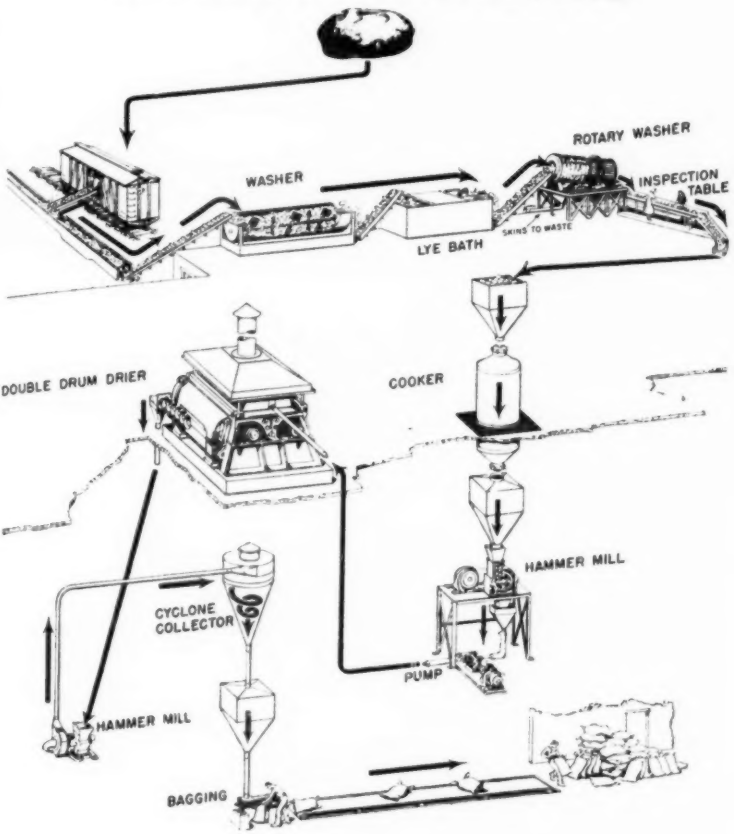

FIGURE NO.4

and, while still hot, are fed to the drum drier, a uniform layer is deposited on the drums.

This principle is being used by large distillers today to meet the emergency demand for potato flour.

Summary

Ground, raw potatoes may be dried with or without pressing in either steam tube driers or direct heat driers, but the former are generally safer. The product can be used for food or with slight modification for certain grades of flour.

Sliced potatoes if coated with a small amount of dried ground potatoes may be dried in direct-heat rotary driers to produce food or certain grades of flour. The process is safe but probably slightly more expensive than drying ground potatoes in steam tube driers.

Finally, drum driers of the type used for distillers, solubles, and other products may be used for making potato flour.

SUMMARY OF PAPERS PRESENTED AT THE POTATO CONFERENCE HELD AT THE EASTERN REGIONAL RESEARCH LABORATORY

(Continued from the April issue)

Disposal and Utilization of Potato Starch Factory Wastes. Mr. Edwards pointed out that wastes from white potato starch factories were of two types (a) protein water containing about 80 per cent of the protein in the potato and consisting of 99 per cent water and 1 per cent solids, and (b) potato pulp consisting of 96 per cent water and 5 per cent solids. These solids usually contain more than 40 per cent starch.

No economical method of recovering the solids from the protein water is known. They are present in too small a quantity. In the case of the pulp, however, the Laboratory has published a recommended procedure based on the Bureau's experience of recovering the pulp from about 2 million pounds of potatoes and on a knowledge of German techniques. The process is as follows:

To the pulp slurry from the factory there is added enough lime to saturate the water associated with the pulp. The mixture is then passed over a dewatering screen and through two rotary presses in series. This reduces the moisture content to approximately 70 per cent. In this condition it can be satisfactorily dried in a steam tube dryer. The dried pulp would analyze about as follows: crude protein 4.81 per cent; crude fat, 0.20; crude fiber, 7.97; and nitrogen-free extract, 72.6 per cent. Based on this composition its selling price might be about $45.00 a ton. The value in Maine, where feed stuffs are at a premium, might be higher.

The capital investment necessary to recover the pulp from a 10-ton per day starch factory would be between $26,000 and $31,500 depending

on the type of dryer employed; *i.e.*, steam tube or direct heat. It was estimated that the cost of production would be less than $45.00 a ton.

Mr. Edwards pointed out the hazard of using a direct heat dryer as the pulp contains about 40 per cent starch and finely divided starch when mixed with air in certain proportions will explode if ignited by a spark. PAUL W. EDWARDS, Eastern Regional Research Laboratory, Philadelphia, Pa.

FERMENTATION PRODUCTS FROM POTATOES. The solids of the potato contain 65 to 75 per cent starch, which can be converted into fermentable sugars which in turn can be fermented into various products, such as ethanol, butanol, butylene glycol, glycerol, lactic acid, citric acid, gluconic acid and others. In the talk production of lactic acid and yeast from potatoes was discussed.

Lactic acid is usually produced from converted starch and various saccharine materials to which inorganic and organic nutrients are added. Dr. Treadway described in detail the production of lactic acid from potatoes without using any additional nutrients. For conversion of starch of the potatoes to fermentable sugars fungal amylases *Aspergillus niger*, NRRL 330 and 337 were used. For lactic acid fermentation several strains of lactobacilli were tested. The best results were obtained with *Lactobacillus pentosus*. Yields of lactic acid varying between 80 and 90 per cent based on the available carbohydrates were obtained. Crude lactic acid can be purified by making methyl lactate and separating the acid from the ester. On the basis of the work done in the Eastern Laboratory one commercial concern made several commercial scale batches of lactic acid from potatoes.

Preliminary results on the propagation of yeast on potatoes were described. The cooked potatoes were hydrolyzed with *Aspergillus niger* NRRL 330. The yeast cells added multiply rapidly and while consuming the sugar present transform the soluble nitrogenous material of the potatoes and the added inorganic nitrogenous substance into insoluble proteins. After 10 hours the number of yeast cells increased 24-fold, and the nitrogen determination showed the presence of 15 per cent insoluble protein (on dry basis). Further work is being done with the view of improving the yield of yeast protein. R. H. TREADWAY, Eastern Regional Research Laboratory, Philadelphia, Pa.

THE MANUFACTURE OF ALCOHOL FROM POTATOES. The use of potatoes as raw material for ethyl or butyl alcohol production in the United States is a relatively recent development. Prior to 1944 such use was negligible. This was not a matter of technology of processing, but was due simply to the inherent economic competitive position of potatoes

as an alcohol source in comparison to other carbohydrate sources which were available at lower cost in adequate amounts.

In Europe, particularly in Germany and Poland, the use of potatoes for ethyl alcohol production has been commercially practicable for perhaps one-half a century and a suitable processing technology has been developed. At least four advantageous factors influenced the European situation—(a) the potatoes usually had higher starch content than the American varieties; (b) the cost of alcohol was a less important consideration since governmental monopolies absorbed the product, constituting virtual subsidies; (c) distinction between alcohol for beverage purposes and industrial purposes did not exist to the extent that is in effect in the United States; and (d) alcohol plants were generally located closer to raw material sources, and were related to the farm economy.

The United States produces more ethyl alcohol than any other country in the world. Sharp distinction is made in this country between alcohol produced for beverage use,—or taxed alcohol,—and alcohol for industrial use, which mostly is tax free. This has had the effect of creating separate alcohol industries,—the beverage (distilled spirits) and the industrial alcohol industries.

In the beverage alcohol field, due to government regulations, only certain specific raw materials may be used for specific products. For example potatoes can serve as a raw material only for the production of vodka, or of special types of liqueurs, which might represent only a very small proportion of the total distilled spirits production. Conversely, there are no legal limitations on raw material for industrial alcohol. However, manufacturing cost imposes selective raw material limitations, because industrial alcohol usually sells at a highly competitive level, ordinarily entailing low profit margins. Historically, the cheapest raw material source has been waste molasses, which formerly accounted for 80 per cent of the total industrial alcohol production. No other available carbohydrate source could compete with it. Even corn, which has 60 per cent starch,—or about five times the amount in potatoes,—was relatively unattractive and represented only 3 to 9 per cent of the actual production.

In recent years the normal economic balances affecting alcohol production have been disturbed. Alcohol sales values have been high, permitting use of raw materials which ordinarily would be uneconomic. Molasses costs have been prohibitively high, grains (until recently) have been rationed and priced virtually out of the alcohol market,—whereas surplus potatoes have been available at times,—at nominal prices. The

industrial alcohol manufacturer is primarily interested in the net cost of a pound of carbohydrate, and the relative ease of handling the material. Hence, when potatoes can fit into the competitive situation, they might be used. Considering the possibilities of future production of synthetic alcohol, or of alcohol from new sources such as wood, sulfite liquor, *etc.*, the possibilities that alcohol production will offer a consistent or significant outlet for surplus potatoes, except under temporary and subsidized conditions is not good. This statement is predicated on *normal* demand, and would be modified if emergency needs for alcohol arose.

Future possibilities of significant expansion of alcohol markets seemingly lies in the fields of synthetic rubber and motor fuel—and synthetic rubber needs are questionable under normal peacetime conditions. As a conceivable possibility, rubber production for peacetime use might represent outlet for 65,000,000 gallons for 100,000 long tons of rubber. However, production of synthetic alcohol may be upwards of 100 million gallons annually in the future, in contrast to the 25 million prewar rate. Considering also the further inroads on alcohol markets being made by direct production of ethyl-derivate chemicals from natural gas, petroleum, and acetylene, plus the competition now developing from methyl and isopropyl alcohols, it can be seen that fermentation alcohol markets are shrinking, rather than expanding. The only exception that can be foreseen is in the possible future use of alcohol motor fuels. Such outlets might be expanded to an amount many times greater than the present total alcohol production. Use of alcohol raw materials, and trends of uses were shown.

Potatoes can be processed for alcohol production without unusual difficulty, except for preliminary handling aspects, and yields are proportional to carbohydrate content. The alcohol can be refined to a quality comparable with alcohol from any other source. There has been some difference between European and American processing methods. In Europe, most production has come from very small distilleries, of farm type. Comparable production units do not exist in the United States. In Europe the steam explosion or Henze method of cooking was largely used, whereas most American plants resorted to the simpler and more rapid method of hammer milling the raw potatoes to a slurry which could be easily handled. However, about a dozen American plants have been equipped to use steam explosion methods. Except for the difference in cooking procedure, the potato fermentation operation is comparable to that used with other raw materials, although by-product feed recoveries are only about one-fourth that from grain.

The yield of alcohol from dried potato slices is about the same as that obtained from an equal weight of corn.

The author concludes: "It may be inferred, that future use of potatoes for ethyl alcohol production, in significant amounts, is likely to be related to comparative economic conditions or on induced use by socio-political expedients.

"There is at least one manufacturer using large quantities of potatoes for production of butyl alcohol. Butyl alcohol markets are more limited than ethyl, and there are only about 5 manufacturers. The same conclusions will stand as for ethyl alcohol." P. BURKE JACOBS, Northern Regional Research Laboratory, Peoria, Ill.

SUN-DRYING OF POTATOES IN SOUTHERN CALIFORNIA. Potatoes were sun-dried in Kern County, California, on a large scale for the first time in 1944. Over 30,000 tons of surplus potatoes were dried in that year on a desert strip 2½ miles long and ½ mile wide. The first contract price was $29.50 per ton to dehydrate the potatoes including land rental, clearing the debris, dumping and spreading the potatoes, puncturing and turning the potatoes, windrowing, picking up and grinding to a meal, purchase of sacks and labor of packaging, and hauling to a central depot.

In the initial operations the potatoes were spread by hand, up to a depth of 4" to 6". Tractors and other mechanical equipment were later used in spreading. Difficulties were encountered in stirring the potatoes during drying. The combination of horse and hay rake was tried for stirring, followed by a "Kansas weeder", the prongs of which stirred the potatoes. Windrowing aided the picking up of the potatoes after dehydration. Removal of dirt constituted quite a problem. The dirt and the petrification caused much abrasion in the hammer mills during grinding to meal and the dirt resulted in ash contents up to 17 per cent.

The potato meal was mixed 1:1 with barley and 1:1 with dried orange pulp for feeding. Feeders discount potato meal approximately 10 per cent or more under the price of barley. At present, a processor can pay only about $2.00 a ton for raw potatoes to be sun dried in order to insure a reasonable profit.

There was no potato surplus in Kern County in 1945 and no sun drying operations were conducted.

In 1946, on account of the large potato surplus and grain shortage, 300,000 tons of potatoes were sun dried. The potatoes were spread on runways and strips of abandoned airfields. Improvements were made in handling the potatoes by use of "bulldozers" and other large equipment such as steam rollers, road graders, etc. Blowers were used to separate the potato meal from crushed rock and to transfer the meal to railroad cars. The 1946 production went mainly into alcohol production.

The 1947 table stock market was strong and only enough potatoes went into sun drying to produce 8,000-10,000 tons of meal. Further improvements were made in breaking up the potatoes; this time rubber-treaded "half tractors" were employed. This equipment did not break up the asphalt runways but still punctured the potatoes satisfactorily. Also a combine was developed to windrow, pick-up, grind and sack the meal as it moved down the field.

During the summer of 1948 unusual difficulties were encountered in that the weather was too cool for effective sun drying. Flies were attracted to the potatoes, and it was necessary to spray the surrounding areas to kill them. HARRY AMENTA, International Fertilizer and Feed Co., Bakersfield, Cal.

FREEZING-DEHYDRATION OF POTATOES IN NORTH DAKOTA. In his introduction, Dr. Wells pointed out that the Red River Valley of North Dakota is really an immense freeze dryer in winter with temperatures as low as 40° below zero.

Formerly Mr. Case had felt that the potato problem would be solved if uses could be found for those potatoes which shouldn't go to market and he still thinks this is true. Out of the 30,000 cars of potatoes grown in the valley, a considerable number normally are fed directly to cattle, hogs and sheep. Objections to direct feeding are the high water content, the inclement weather during the marketing season and the feeders' objections to feeding fresh potatoes.

The talk was based on observations, the first of which was that potatoes spread on the land in the winter and frozen, did not rot during the spring thaw. It was discovered later that the natives in the Andes Mountains had been freeze drying potatoes for a long time. The potatoes do not have to go through freezing and thawing cycles, they will dehydrate if frozen solid only once and thawed out the next day. The potatoes dry suprisingly rapidly and can be spread at any time during the winter. Because of high labor costs, culls should be gotten rid of as early as possible. The ideal situation would be for every farmer or at least every warehouseman to handle his own culls so as to avoid transportation costs. The cattle pick up the potatoes off the pastures and eat them, with no labor costs involved. Feeder cattle pass through the Red River Valley on the way east to market. The packing houses even pay a premium for potato-fed beef.

The carrying capacity of pastures is about double by spreading potatoes on them. Grain yields have been doubled in the same way. Potatoes picked up in May were found to have 82 per cent solids, 71 per cent starch and 0.15 per cent sugar. Machinery might be used to pick

up the potatoes if they were spread on a hard surface. The mummified dried potatoes do not seem to be damaged by heavy rains.

Few exact data are known at present but systematic studies are under way at the North Dakota Agricultural College and the University of Minnesota.

Mr. Case also mentioned the silo method of drying. Early experiments indicate that fermented potatoes lose water readily and thus are more easily dehydrated than untreated potatoes. Apparently the cell walls are ruptured.

This season, 300-400 carloads of potatoes will be spread out on the prairie to freeze dry. Feeders outside the valley are buying up potatoes. W. M. Case, Red River Valley Potato Growers' Association, Grand Forks, N. D.

Use of Ensiled and Dehydrated Potatoes in Livestock Feeding. Potatoes have been fed to animals and poultry for many years. A technical report appeared on this subject as early as 1890. Potatoes on the dry basis may be compared with white corn in feed value. Carbohydrate and protein contents are about the same, and neither contains carotene. Potatoes are lower in phosphorus than corn. A protein supplement is generally required when either potatoes or corn is fed.

Potatoes dehydrated by many different processes have been used in feeding practically all types of livestock. Swine digest potatoes best of all animals, assimilating 90 per cent of the organic matter. Cattle, sheep and horses digest potatoes well. Variable results have been obtained with poultry, the dehydration procedure affecting the digestibility. From 10-30 per cent of a grain mash may be replaced with dehydrated potatoes for poultry feeding. Fifty per cent of the grain used in feeding swine can be satisfactorily replaced with dehydrated potatoes. Experiments are being initiated in duck feeding, in which it is hoped to replace upwards to 50 per cent of the grain with dehydrated potatoes.

The Bureau of Dairy Industry has conducted research on methods of making potato silage and tests on its feeding to dairy cows. When ensilage is produced from raw potatoes, it is best to add grain or preferably hay to reduce seepage losses. If 15-22 per cent of hay is added to the potatoes as they are chopped in an ensilage cutter, excessive loss of nutrients due to seepage is eliminated. The cows made good weight gains on potato silage and maintained their milk production. It appears the potatoes fed in moderate amounts after milking do not affect the odor or flavor of milk. The quantity of raw, chopped potatoes or potato silage fed should not be more than about 4 pounds daily per 100 pounds live weight.

A study of cooked potatoes silage and its feeding was recently made by the Bureau of Animal Industry. The potatoes were steamed and placed in experimental silos at approximately 35°, 63°, and 85°F. The 63° temperature was found best in that it was high enough to promote fermentation and inhibit putrefaction but not high enough to cause undue loss of nutrients. About 25 per cent of the carbohydrate was lost during one year's ensiling at the intermediate temperature. N. R. ELLIS, Bureau of Animal Industry, United States Department of Agriculture, Washington, D. C.

ENSILED POTATOES AND THEIR FEELING. The method used for ensiling the potatoes was of German origin and has been described by Karl Brandt, Economist, Food Research Institute, Stanford University, California. To be economic, the potatoes must be obtainable at little or no cost, under 20 cents per hundred weight. Approximately one-third of the solids are lost during the ensiling period as it was carried out.

The potatoes were cooked with steam in the truck bodies under canvas for 45 minutes before dumping into trenches. Drainage was provided at the bottom of the trench. After being packed in, the potatoes were covered with about 3 feet of pea vines. The loss in weight during fermentation was about 15 per cent and the volume shrinkage was about 20-22 per cent. The drainage liquor contained 1.6 per cent protein, 1 ash and 7.8 per cent total solids. Small scale tests show that the leaching loss largely can be prevented by mixing 25 pounds of chopped alfalfa hay with every 400 pounds of cooked potatoes.

The potatoes were fed to hogs after 60-90 days in the trenches. About 5 pounds of silage supplemented by 2 pounds of a mixed barley-alfalfa ration were fed per 100 pound hog per day. It was estimated that 300 pounds of feed solids made a 100 pound net gain.

The pre-war potato economy was much better balanced in Germany than in the United States. Buffer outlets are needed here to prevent the sharp price changes occurring. A 10 per cent surplus will cause a drop in price of 40 to 50 per cent. In the United States the per capita consumption is only 2.5 bushels while in pre-war Germany it was 30 bushels of which 9 bushels were used as human food. A means of taking care of the surplus which occurs in good crop years is badly needed. Probably this can be done as at present or by price support by an industry-wide agreement, possibly by a per sack levy on marketable potatoes, or by a combination of a support price, not necessarily 90 per cent of parity, and industrial utilization. As we have less and less expendable natural resources, we will have to have an intensive stable agricultural economy coupled to vast industries for converting our crops to needed materials.

Potatoes will contribute a large share toward an adequate national economy. H. G. ZUCKERMAN, Weyl-Zuckerman and Company, 501 Bank of America Building, Berkeley 4, Cal.

PROBLEMS IN THE PRODUCTION AND STORAGE OF POTATOES FOR FOOD USE. In spite of a declining per capita consumption, the consuming public is becoming more critical in its choice of potatoes. Probably potatoes will have to be separated into different classes according to uses. At present, the main part of the annual production is sold just as potatoes although about 20 million bushels of selected varieties were used the past season for chipping. Although certain varieties have outstanding characteristics, these vary when the potatoes are grown in different localities. For example, the starch content of Katahdins varied from 10 to 15 per cent when grown in different localities.

Great care is needed in handling potatoes at every step on the way from the field to the kitchen. Minor injuries tend to develop into major injuries later. Around 50 per cent of the potatoes are often injured during harvesting and storing. Washing tends to increase the extent of injury, especially that due to decay organisms. Attempts to combat this are being made by chlorinating the wash water, by drying the potatoes immediately and by use of refrigeration.

Potato diseases often cause considerable loss. Bacterial soft rot in early potatoes often enters through cuts and bruises, especially if the potatoes are exposed too long to hot sun. Vines should be dead about 10 days before digging where late blight is prevalent to prevent its spread; rapid cooling and low temperature storage, 40° F., also help. Stem end browning should properly designate only that of non-parasitic origin. Fusarium infection and vine killing operations cause similar effects. Net necrosis is caused by leaf roll virus. Freezing necrosis is similar. Greying of the flesh after boiling or baking and a browning during deep fat frying or dehydration are disorders about which not much is known.

Storage temperature is very important. In general 40-50° F. is the most satisfactory, 50° for short storage periods. Sprouts grow very slowly in this range. Potatoes from 40° storage should usually be conditioned before use. Sugar develops in low temperature storage and may be decreased by holding the potatoes at 60 to 80° F. for a period.

Sprout inhibitors may be used successfully if the directions for use are followed closely. No change in flavor or quality was detected after the use of two commercial sprout inhibitors. Storage at 50° F. or above may cut down the loss in ascorbic acid. Shell bins cut down shrinkage in storage. These bins have air tight walls and the air circulates around rather than through them. R. C. WRIGHT, Bureau of Plant Industry,

and Agricultural Engineering, United States Department of Agriculture, Washington, D. C.

"A" THE POTATO PROGRAM OF THE WESTERN REGIONAL RESEARCH LABORATORY. Four phases of potato work at the WRRL were discussed.

1. *Potato Dehydration*: Results of investigations at the Western Regional Research Laboratory on dehydration have been published in the U.S.D.A. Miscellaneous Publication No. 540, Vegetable and Fruit Dehydration, and in several technical articles.

These investigations showed: (a) The type of potato which becomes white and mealy when cooked is preferred for dehydration. (b) Overblanching of high-density potatoes resulted in a product having a hard shell and a hollow center which caused mushiness in the reconstituted product. (c) Underblanching caused darkening during processing and hastened deterioration during storage. (d) Sufficient sulfite to produce a dehydrated product containing between 400 and 500 ppm. of sulfite markedly improves the color and increases Vitamin C retention and improves storage quality. (e) Data were secured to determine the effects on drying time of such variables as air temperature, humidity and velocity; size and shape of the cut pieces of potato; and the density of loading on the drying tray or conveyer.

2. *Deterioration of Dried Potatoes*: Storage tests have emphasized the effect of high temperature in hastening deterioration of dehydrated vegetables. Sulfiting, inert gas packaging, low-temperature storage and in-package desiccation have been investigated. The use of in-package desiccation extends the storage life of dehydrated potatoes at room temperature about six-fold. As one phase of the study of deterioration of dried potatoes during storage, a method has been developed of measuring the amount of discoloration by solution of the pigment formed and photometrically measuring the intensity of the color.

3. *Composition of Potatoes as Related to Specific Gravity and Quality*: Potatoes at the extremes of density range are unsuited for commercial usage. Low density potatoes are watery and waxy and produce a translucent product of poor reconstitution properties, while potatoes of very high density often result in products which slough badly on cooking or have low cohesive properties. The causes of these peculiarities are obscure.

4. *Potato Utilization for Food*: The major emphasis of our present research is placed upon the development of new food uses for potatoes. This is a logical means of counterbalancing the decline in consumption.

A successful commodity must fulfill one or several of the following objectives:

1. Provide a more economical method of using potatoes.
2. Provide a cheaper, easier or less time-consuming method of utilization.
3. Offer a better or at least equal quality product.
4. Provide a new appetite or taste appeal.
5. Provide an acceptable and economical substitute for a similar product from another source (potato flakes *vs.* corn flakes).

Prepared potatoes for hotel and restaurant trade (that is, either peeled or sliced for French fries) offer several advantages. The industry of preparing and marketing such potatoes is already well established in a number of large cities.

We are investigating methods of preserving peeled potatoes.

Frozen prepared potatoes and dehydrofrozen potato slices for French fries appear to offer much promise of an industrial method of preparing potatoes for wider consumer use.

Dried potato products are relatively stable; they offer a large variety of possible food uses; and their cost of processing, storage and shipping is low.

The preparation of potato chips from dehydrated potato slices is entirely possible and offers many advantages, such as stable quality, ease of handling, savings in weight, storage space and refrigeration.

We have produced a potato crunchy or puff by dehydrating potato cubes at a sufficiently high temperature to case harden the exterior and produce a pressure in the interior which puffs out the cube as it dries.

A list of 20 uses for potatoes in food products was given. FRANCIS P. GRIFFITHS, Western Regional Research Laboratory, Albany, Cal.

SECTIONAL NOTES

ALABAMA

In spite of many close calls and worry Alabama is harvesting a better than average commercial potato crop. We ran close calls with frost in March, early blight and some lack of moisture during the latter part of March, excessive rains in April, and the worst blight condition in five years during the latter part of April until the present time. We have had few fields where yield was materially reduced by blight but as a general rule most of the fields were held up by a quick application of copper or Dithane, or Parzate in dust or spray forms. We started shipment earlier to take out fields that were down with late blight and with our set-up all the farmers started digging thus sending too many green potatoes to market in poor shape. Nature aided us by

giving a week to ten days when it was impossible to get in the fields and now it is the belief that most of the crop will ship in good shape. To give us another extreme condition the 6th of May was supposed to have been one of the hottest days on record in Mobile according to the weatherman's prediction.

Our approximately 15,000 acres of early commercial potatoes should yield better than 4,000 cars and today the price is $2.60 for No. 1 Reds (Triumphs) and $2.75 Whites (Sebago) cash to the grower at the shed. Most of our fields will yield nearly 100 bags per acre and at this price our farmers should make some money. The Government has not had to buy many B and cull potatoes as yet. Our dealers think that perhaps the market outlook is better than normal for the balance of the season.

We think we have learned that Late Blight can be commercially controlled by either dust or spray even under very severe conditions in Alabama. The most important factor in control seems to start a regular program early and just apply weekly applications if possible.

It seems now that Alabama should be happy about our potato crop. —Frank E. Garrett.

Indiana

We have considerable acreage planted to early maturing varieties, and the later maturing varieties will be planted within the next week to ten days for most localities in the state. The southern area, however, will delay planting until the latter part of May. Apparently our growers are planting a little earlier each year in order to escape some of the summer drought and also to prevent, if possible, the attack of any late blight. Our growers are well equipped with spraying and dusting equipment and each year we find that more and more of them are putting in overhead irrigation, using portable pipe. We will maintain about the same acreage as we have the past four or five years which no doubt will keep us in the home-consuming state rather than for any potatoes for export. Things are very quiet concerning marketing agreement.—W. B. Ward.

Michigan

As a result of climatic conditions this spring our crops are advanced two weeks. Generally, throughout the state we had below normal snowfall last winter, followed by deficient rainfall in April.

Some early planting has started, but most of the early areas will plant during the first half of May and the late areas which comprise the largest

part of our acreage will be planted the last half of May and early part of June.

The acreage planted to potatoes in the state this year will probably be 10 per cent below last year's acreage.

Our table stock is about cleaned up. The Government shipments were higher this year than they have been at any time during the support program.

Michigan's operated under the marketing agreement which prohibits the movement of B's and two's. This has materially helped our marketing program by the removal of this low grade from commercial channels.

Certified seed acreage indications are far above our normal planting. This past season has been quite pleasing to the seed growers. Our shipment went out early, with only an occasional car still to be shipped.

Indications are that the acreage entered for certification this year will show some shift in varieties, declining in Russet Rurals and increasing in Katahdins.

Of interest to many of the members of the American Potato Association is that E. J. Wheeler, Plant Breeder of the Michigan State College, has just returned from a year's stay in Japan with the U. S. Army where he assisted in a potato production program there.—H. A. Reiley.

Nebraska

Shipments of Nebraska potatoes terminated, for the most part, about the 15th of April. The volume was somewhat higher than last year, with both table and Certified seed. On the basis of grade, the quality was not so good as last year. Fewer cars of No. 1's and a great many more cars of No. 2's were shipped on the table market this season.

Planting operations in the central Nebraska area are almost complete at this time. Considerable rain and two late spring snow storms have delayed growers in this area from two to three weeks. To date, we have no report on acreage planted in this area.

In the western late potato section of Nebraska, planting will not begin until the first week in June. At present, growers are working over their seed potatoes and treating them in hot formaldehyde. Favorable weather has enabled farmers to carry on their field work ahead of schedule. All small grain crops are in excellent condition.

Only a small part of the late potato crop in western Nebraska was diverted to the Government under the past season's price support program. Most growers were able to sell their potatoes through local shippers at comparable prices. Growers in western Nebraska are pleased

with certain aspects of the Government potato support program for 1949, particularly payments based on a No. 2 minimum. They are quite concerned about the reduced acreage allotments. Some are complying, others are not signing up because they do not wish to reduce their acreage to the extent for which the allotment calls.

At this time records are being completed and the books closed for the fiscal year in certification work. District and annual meetings of the Nebraska Certified Potato Growers are being held. Applications for certification in 1949 are just beginning to come in. It is estimated that the Certified acreage in Nebraska will be about the same as last year.—WARREN TRANK

NEW JERSEY

Most of our potato crop was planted under favorable conditions. Nearly all plantings have emerged so that a very good stand is evident in the majority of our fields.

Considerable fusarium dry rot was found in some lots of seed when it was cut, and seed piece decay was observed on a few farms both before and after planting. Our growers have again been urged not only to treat their seed but to handle it in a manner that will allow a good layer of corky tissue to form on the cut surface. These precautions, if followed, will reduce losses from fusarium seed piece decay.

The potato acreage has been greatly reduced since most growers are complying with the reduced acreage goals. The Crop Reporting Board of the Bureau of Agricultural Economics estimates this cut to be 24 per cent below the 1948 planted acreage. This is the greatest reduction listed by any state. In order to increase yields per acre many growers have spaced their potatoes closer in the row than in former years and some are planning to side-dress their potatoes with more fertilizer during the growing season.

The Annual Summer Meeting of the New Jersey State Potato Association has been tentatively arranged for June 14 at 1:30 p.m. at Clifford and Richard Ely's farms located 2 miles east of Hightstown on the Hightstown-Freehold Road.—JOHN C. CAMPBELL.

OREGON

Klamath District was part of the marketing agreement area embracing all of central Oregon, and the Klamath Basin in Klamath County, Oregon and Modoc and Siskiyou Counties in California operated under a marketing agreement in 1948. The cull regulation and two-inch minimum regulation were in effect. The general feeling here is that this type of regulation is satisfactory and was instrumental in keeping

undersized potatoes off the market. There is a lot of discussion on proposed potato support programs. The yields and the quality of the 1948 crop were the best on record. Although some credit for this condition belongs to a favorable season, undoubtedly the potato disease and improvement program carried on here is giving very fine results.

Good seed, preferably foundation or certified, combined with roguing and disease control seems to be particularly effective. It looks now as if 16,500 acres grown in 1948 will result in the shipping out of over 11,000 cars, a district record. The acreage in 1949 will be about the same as 1948, and more than 90 per cent of the acreage should be in compliance.—C. A. HENDERSON

SOUTH CAROLINA

The potato crop is now within two weeks of harvest and it promises to be one of the best on record. Until late blight was reported yesterday no disease problems had arisen and rainfall had been adequate for good growth. The movement will begin on the 16th of May with a few early crops being moved the preceding week. This is about the time for movement to become general, perhaps a week earlier than many crops. The use of copper-DDT dusts and sprays have been consistent and unless the weather changes radically no great damage from blight is anticipated. If summer showers should become general, and temperatures remain low, blight could still do a lot of damage to the crop.

Attention has turned from growing to getting the washers into operation and arranging for vine killers. A large portion for the crop will be washed Sebagoes and the use of vine killers has become a fairly general practice in the more important production areas.

Every one is hoping for a good market and at this time the prospects are fairly promising.—W. C. BARNES

WASHINGTON

I cannot give you very much news about the potato industry in this state at the present time. Indications are that somewhat more than the allotted acreage will be planted. Quite a few potatoes are going in on land recently brought under cultivation in the Columbia Basin project. Few if any of these growers have allotments. They seem to feel that they will be able to market their crop. The season so far is somewhat early and quite dry. In the Moses Lake area and the Yakima area the growers are sticking pretty closely to their allotted acreages. Outside of these two areas, there is some over-planting.

The farmers with whom I have talked seem to approve of marketing agreements and Federal regulations generally. They apparently believe

that while regulation is not without some aggravations it is better than the old style free competitive farming which seems to be a thing of the past.—M. R. HARRIS

CANADA

The export sales of certified seed potatoes in Canada from the 1948 crop have been the highest on record. Both table and seed potatoes are in short supply in many of the provinces. The holdings in Prince Edward Island and New Brunswick are fairly low indicating that the movement has been very satisfactory. Under the price support program handled by the Dominion Department of Agriculture, potatoes will be bought by the Dominion Government as of the 1st of April at $1.25 per cwt. on the farm, on the Canada No. 1 basis, in the provinces of Prince Edward Island and the larger producing areas in New Brunswick. The weather has been extremely dry in the prairie provinces and the prospects are not too bright although very little planting has been done as yet. In other parts of Canada, conditions are somewhat better and the indications are that in Quebec there will be a larger acreage planted than that in 1947.—J. W. SCANNELL

PROVINCE OF ONTARIO

Practically all supplies from concentrated potato-producing areas have now been marketed. In other areas where regular marketing practices have been established, small quantities remain on many farms. Large quantities continue to arrive from the Maritimes, with often each day from 30 to 40 cars on track for the Toronto market alone. Markets continue firm at Support Price levels, which for Toronto, wholesale to retail, bring $1.65 to $1.70 per 75 lb. bag; with 15 lb. pre-packaged 37 to 39 cents; and 10 lbs., 26 to 28 cents. There has been an excellent demand for seed with 49 carloads being exported from one area.

Planting of the early crop is about complete with plants showing above the ground in the first planted fields. The foremost subject uppermost in the minds of many late potato growers is the establishment of central facilities for grading and warehousing in principle potato areas. Other topics being given attention are; cost of production survey; scab research; soils high in phosphate to improve cooking quality and avoid excessive mechanical injury; grade enforcement; control of bacterial ring rot; variety tests; toxic effects of DDT; high yield competitions and freight reduction on seed from Northern Ontario.

The Potato Committee, Ontario Crop Improvement Association met recently (April 20th) at the Parliament Buildings, Toronto for their spring session. Reports were heard from Departmental Officials con-

cerning various angles, and discussion centered around timely subjects relative to the industry. These included resolutions passed at a recent annual meeting, supplies on hand and price support program, high yield contests, bacterial ring rot program, revision of price lists, certification matters, grade enforcement, disposal of culls, control of weeds by pre-emergence sprays, and policy for seed production in Northern Ontario.

Of particular interest was the report by Dr. H. L. Patterson, Director, Farm Economics Branch on Cost of Production Survey and another from Dr. G. H. Berkeley, St. Catharine's on the subject of the cooperative Scab Research Project.

Grower representatives were very much concerned about the Dominion-Provincial Warehousing Policy and urged the early establishment of central storage grading and packaging facilities in concentrated potato-producing areas. Other timely topics which received attention were the effects of increased quantities of phosphate on the cooking quality of potatoes, and the reported dangers from accumulated amounts of DDT in the human body and on the growth of crops following potatoes in the rotation.—R. E. Goodin.

CHARLES FREDERICK CLARK—1873-1949

F. J. Stevenson[1]

Dr. Charles Frederick Clark died at his home in Riverside, California, on May 8, 1949. He will long be remembered for his work in potato breeding in recognition of which he was elected an honorary member of the Potato Association of America at its meeting in Chicago, December 1947.

Dr. Clark was born at Glover, Vermont, August 13, 1873. He received a Bachelor of Science degree from the University of Vermont in 1897, a Master of Science from Cornell University in 1907, and a Ph.D. from the same institution in 1909. He worked as an agronomist and plant breeder at Cornell University from 1906-1910 when he accepted a position with the Bureau of Plant Industry. Although he retired in 1941 he never lost interest in potato breeding, potato varietal classification, and other investigational work. At the time of his death he was actively engaged in revising United States Department of Agriculture Circular No. 741 entitled, "Descriptions of and Key to American Potato Varieties."

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[1]Principal Geneticist, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture.

His work and publications are a monument to his memory, but his most outstanding contribution to the industry is the Katahdin potato. It was of great satisfaction to Dr. Clark that this variety was accepted so generally by growers. About two months before he died he wrote: "The widespread endorsement of the Katahdin by the potato growers of this country as indicated by the volume of seed produced is very gratifying. When it was released to growers 17 years ago I had no expectation that it would ever occupy such an important position in the potato industry. I remember that during the early days of testing the Katahdin to determine its qualifications one of our associates remarked: 'You have got to go some to beat the Rural New Yorker.' Today the Rural New Yorker is listed in the certified seed production report as one of the less important varieties with a production in 1948 of 42,005 bushels compared with 13,385,278 bushels for Katahdin. Katahdin was not an accidental discovery in our progenies but was the result of much study and effort in the selection of the parents which were used in the cross, as at that time resistance to mild mosaic and fertile pollen were almost non-existent in the material we had available."

Painstaking, thoughtful work was typical of the man. He was kind and courteous and in his dealings with his associates he lived closely to the Golden Rule. He was always a Christian gentleman.

BOOK REVIEW

POTATO PRODUCTION — E. V. HARDENBURG

Published March 29, 1949 by Comstock Publ. Co., Ithaca, N. Y.

Here is a treatise written primarily as a college text but so designed as to be useful also for potato growers, for commercial interests and for teachers in secondary schools. The book covers almost every phase important to the potato industry. Included among its 17 chapters are such topics as botany and plant development, climatic and soil relationships, rotation and soil management, fertilization, seed, planting, varieties, disease and insect control, tuber defects, harvesting, storage, grading, marketing, quality, breeding and the economics of production. All subject matter is based on the author's teaching and research experience and a review of research of the past 30 years. Over 200 references to experimental work are cited in the text. Included among the 129 illustrations are the 26 varieties of potatoes now commercially important in the United States and Canada and nearly all of the tuber defects to which the potato is subject. There are 63 tables of data each of which is cited

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as an example of results of the best research on the subject being discussed. It is indeed the only up-to-date potato text now available in this country.

To the credit of the publisher, the book is printed in very legible type on glossy paper and bound in heavy brown cover. The illustrations are especially clear and instructive of some point under discussion. Available from Comstock Publishing Company, Ithaca, N. Y. $3.00.

STATEMENT BY THE NATIONAL POTATO COUNCIL

Testimony of the National Potato Council before a Special Subcommittee of the House Committee on Agriculture, Honorable Stephen Pace of Georgia, Chairman, presented by Claude E. Botkin, farmer of Arvin, California, on behalf of the National Potato Council. This statement contains the recommendations of members of the National Potato Council as condensed and summarized by a Special Program Committee composed of Mr. Botkin, Mr. C. C. McIntire, Perham, Maine; Mr. William M. Case, Grand Forks, North Dakota; Mr. John Wickham, Cutchogue, Long Island, New York.

The National Potato Council is an organization of potato growers with members in all important producing areas. The Council was organized in May 1948 and incorporated February 2, 1949, in Washington, D. C. Most of the commercial production of white potatoes in the United States is represented in the Council's membership.

Our officers are S. A. Wathen, Fort Fairfield, Maine, President; W. B. Camp, Bakersfield, California, Vice President; John C. Broome, Aurora, North Carolina, Secretary; and William B. Duryee of Allentown, New Jersey, Treasurer.

Potato producers of the United States, speaking through the National Potato Council, are very appreciative of this opportunity to appear before this Subcommittee to give you the benefit of our knowledge and experience in your worthy attempt to find a solution to our perplexing agricultural problems.

First of all, our farmers are keenly conscious of the fact that potatoes have become the "whipping boy" of the agricultural price support program. Therefore, we welcome this opportunity to say to you gentlemen that the actual operation of this program is not as potato men expected it to be, nor is it as they desire it to be.

The results have been due more to the exceptionally favorable climatic conditions that predominated the last few years, than to the intention of potato men, or to any failures of proper planning on the part of the Department of Agriculture.

As a matter of fact, potato growers, on the whole, have done almost exactly what the Department has requested of them under the programs that have been in effect.

As a group, potato farmers have complied with the Department's acreage program. In each of the last three years, the potato planted acreage has not even equalled the national acreage recommended by the Department. The indicated 1949 acreage is 1,900,000 acres, the lowest in seventy years.

In view of this wholehearted compliance with the program, it is obvious that the costs of the potato program have been due primarily to high per acre yields and to a sharp falling off in consumption.

In addition to the unusually favorable climatic conditions, there have been other factors, such as the use of new types of insecticides, and improved cultural practices.

The National Potato Council is frank to say that potato growers themselves are deeply concerned over the cost of the program and have repeatedly sought methods whereby it might be reduced.

The record on this is rather complete. As far back as May, 1948, potato growers, meeting here in Washington, recommended to their Senators and Representatives that changes be made in the potato price support program. They worked out what they thought, at that time, was a program that was practical, workable, fair to the consumer and equitable to the potato grower.

We would like to remind this Subcommittee of the most pertinent recommendations at that time:

1. That potatoes be supported on a flexible price support basis which would allow for adjustment as circumstances seemed to require.

2. They recommended that potatoes be supported at a price not less than 60 per cent nor more than 90 per cent of parity. They specifically recommended a support price materially lower than the 90 per cent then in effect.

3. They asked that, where feasible, marketing agreements be made one of the requirements of eligibility for price support, thus guaranteeing to the consumers the best that was produced.

a. We do not believe it is right for the Government to be buying good potatoes for diversion while industry is putting the culls on the market.

b. We feel that under the price support program we are obliged to give the consumer the best grades and not the poorest.

4. They recommended that acreage controls, production and marketing controls and other means be made available to the Secretary to use as circumstances demanded.

Following those recommendations, the Secretary of Agriculture reduced the rate of the support price for potatoes from 90 to 60 per cent

of parity and potato producers have accepted and are supporting this very sharp reduction in the support price.

Again, as recently as February 23, 1949, the National Potato Council gave full approval to this lowered support price program by saying to Members of Congress, and to the Department of Agriculture, that it believed the current program should be given a fair trial before changes were made.

For the last two days, the National Potato Council has again been in session and again welcomes the opportunity to present to this group our recommendations for what we think would be a sound and workable program that would be fair to the grower, fair to the consumer and satisfactory from a standpoint of administration by the Department.

In brief, we present the following main points that we feel should be incorporated in any long-time agricultural program developed by this Congress:

1. We recommend that the flexible price support system allowing the Secretary to set support prices from 60 to 90 per cent of parity be retained.

2. We recommend that any price support be contingent upon compliance with acreage goals and also marketing agreements, wherever feasible. We believe marketing agreements will provide for the consumer the better grades of potatoes.

3. We recommend that, if practical, a program to make possible the use of compensatory payments or production payments be developed and made available to the Department for use if necessary to enforce compliance with production programs.

4. We recommend that a definite formula for determining state potato acreage allotments or goals be incorporated in long-time legislation.

Potatoes are a vital food crop equal in importance to any crop produced by American farmers.

Constructive progress has been made in adjustment or acreage in an attempt to bring production in line with domestic needs.

There are many adjustments ahead in all segments of our national economy. It is our feeling that the difficulties of the potato industry are a forerunner of some of these problems which eventually will be confronting other groups in our nation.

Potato growers have been the first farmers of this country to specifically set forth their ideas and plans for a peacetime program for their industry. As has been stated, this was basically set forth a year ago and is reaffirmed in our statement today.

Erratum

The graphs are the Figs. 1 and 2 referred to on pages 49 and 52 of the February 1949 issue in the article entitled "The Effect of Time of Harvest, Variety and tSorage of the Ascorbic Acid Content of Potato Tubers" by W. C. Kelly and G. F. Somers.

Figure 1

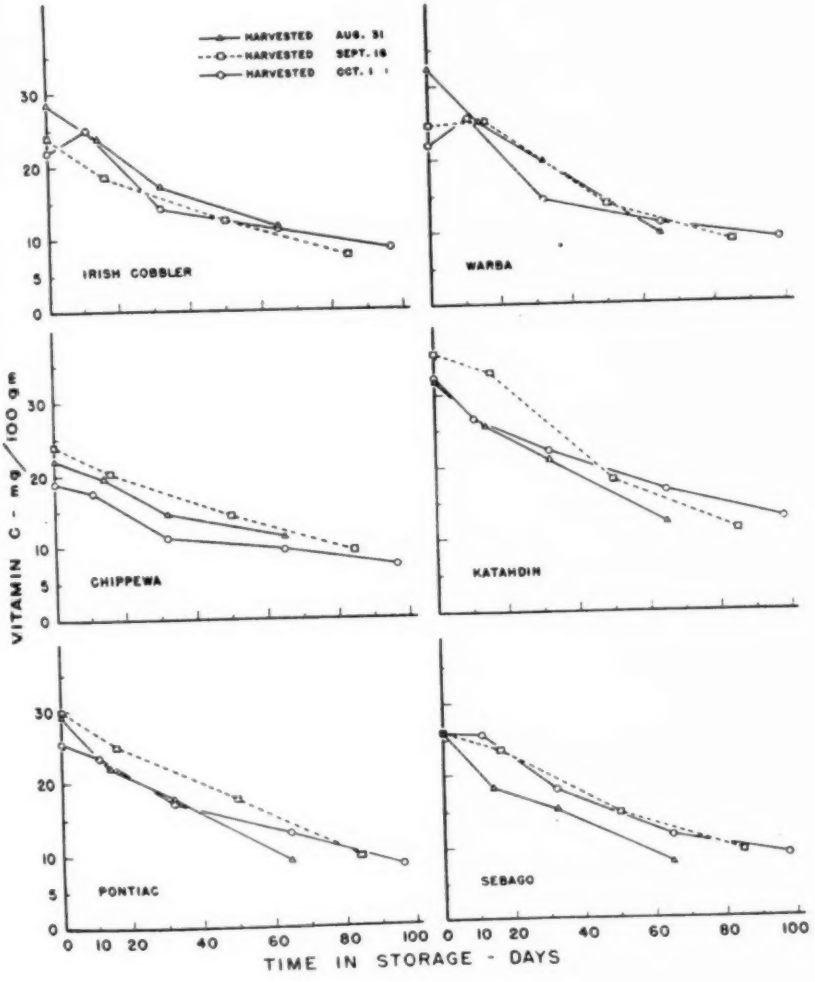
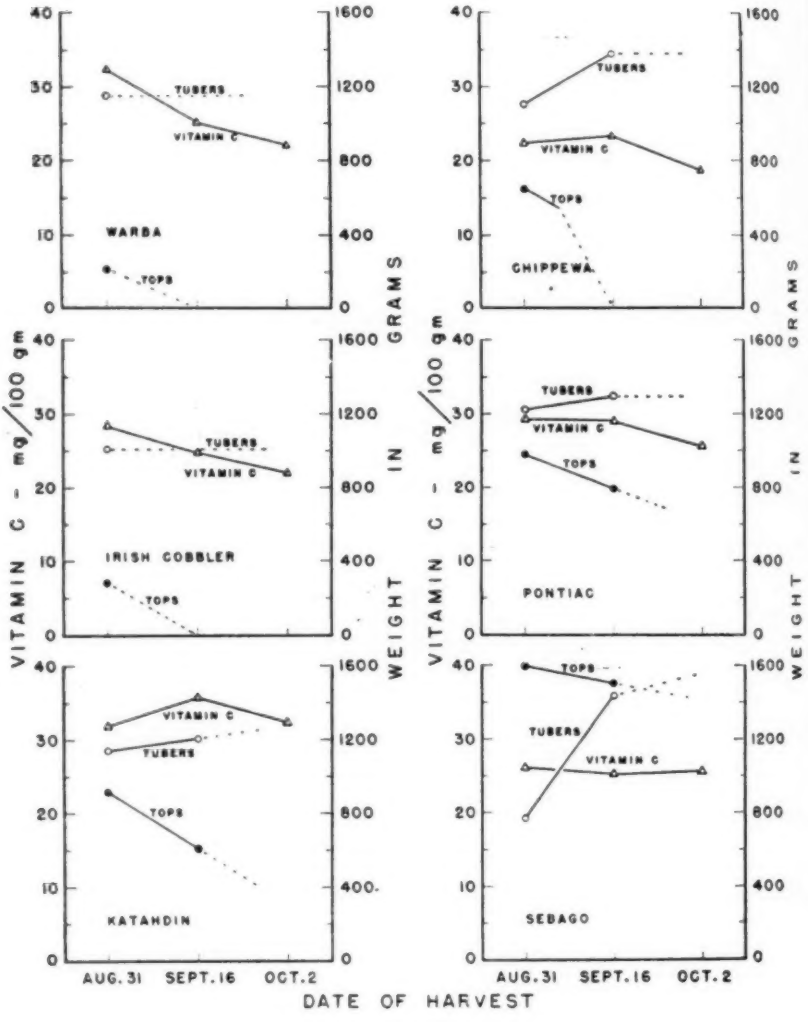


Figure 2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SEPT. 16
OCT. 2
DATE OF HARVEST